

The Long-Baseline Neutrino Experiment Project

LBNE Project Status

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Project Manager

Interim International Executive Board Meeting
23 September 2014

Outline

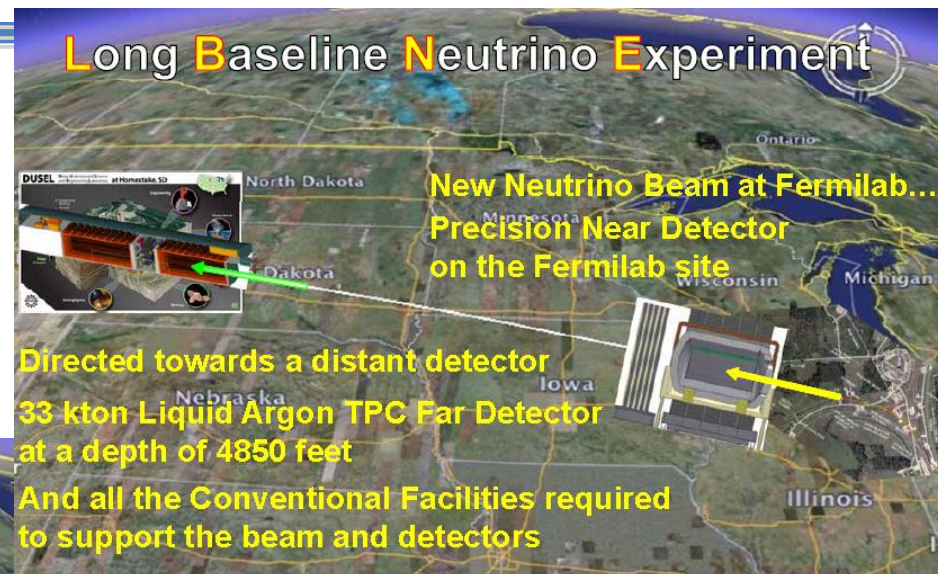
- What LBNE Project has been
 - Major configuration decisions and changes
 - CD-1 accomplishment: what it means
- Post CD-1 (2012) activities to the present
- Overall budget and schedule
- Goals/priorities/budget for FY15

Major Configuration Decisions before CD-1

- At DOE CD-0 (mission need) in January 2010, early conceptual stage had many alternatives:
 - 2 far detector technologies at shallow and deep depths at SURF
 - 4 near detector technologies
 - 2 beam extraction points with 2 beamline depths
- Nov 2011: decided to use MI-10 beam extraction point with a shallow beamline profile to put the target at natural grade
- Dec 2011: decided FD would be LAr TPC at 4850L instead of WCD
- Mar 2012: decided NND would be LAr TPC with FGT as alternate

2012 – Reconfiguration and CD-1 Approval

After having a full conceptual design, cost, & schedule reviewed for the full LBNE scope in March ...



At DOE's direction, we reconfigured in 7 months to produce a phased program at the same time significantly reducing costs across the project, achieving CD-1 approval for an initial scope/cost/schedule in December.

CD-1 and Post-Approval Strategy

Critical Decision 1
Approve Alternative Selection and Cost Range
of the
Long Baseline Neutrino Experiment (LBNE) Project
(Line Item Project 11-SC-40)
at the
Fermi National Accelerator Laboratory and
Sanford Underground Research Facility
Office of High Energy Physics
Office of Science

Purpose

The purpose of this paper is to document the review and approval by the DOE Office of Science Energy Systems Acquisition Advisory Board-equivalent for Critical Decision 1 (CD-1) "Approve Alternative Selection and Cost Range" for the Long Baseline Neutrino Experiment (LBNE) Project at the Fermi National Accelerator Laboratory (Fermilab) and Homestake Mine

CD-1 APPROVAL

- Represents DOE's intention to support the project at the approved budget range of \$0.8M - \$1.1M
- Necessary strategic step to secure project for U.S. and provide basis for discussion with partners
- Allowed for placing detector underground, increasing mass, building a near detector
- Allows adjustment of DOE-funded project scope to enable best path forward
- WE WANT TO USE THIS FOR AN LBN PROJECT

Tailoring of the scope definition prior to CD-2 to enhance scientific capabilities may also be considered. The physics opportunities offered by the beam from Fermilab and the long baseline may attract the support of other agencies both domestic and international. Contributions from such other agencies offer alternative funding scenarios that could enhance the science capabilities of the Project. If additional domestic or international funding commitments are secured sufficiently prior to CD-2, the DOE LBNE Project baseline scope could be refined before CD-2 to include scope opportunities such as a Near Neutrino Detector complex at Fermilab or an underground location at SURF for the far detector.

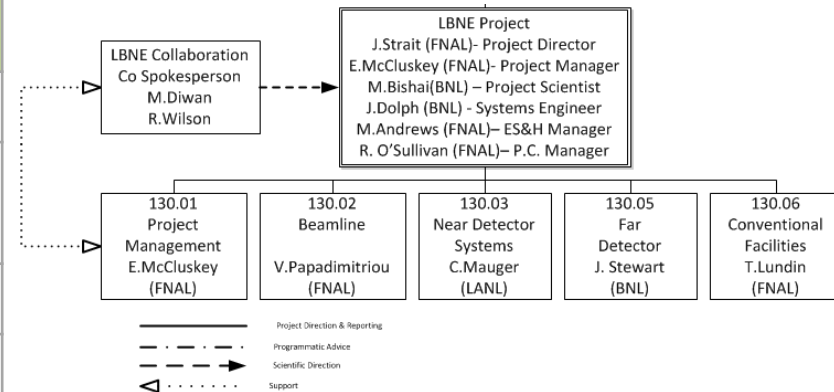
the neutrino mass states, would not be obtained, compromising the ability to understand the matter-antimatter asymmetry and resulting dominance of matter in the universe.

To meet the scientific and technical objectives for the LBNE experiment, the following draft key performance parameters have been developed.

Since CD-1

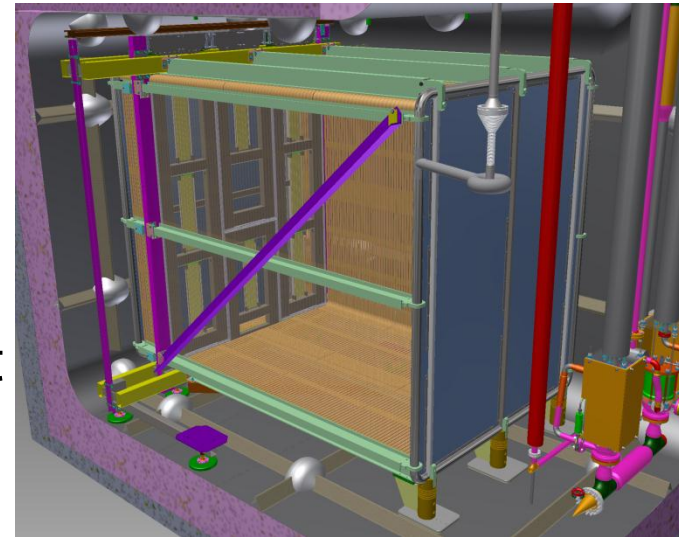
- We have evolved the project
 - To establish a reference scope for what might become an international project as described in the LBNE Science Document
 - To establish the associated cost/schedule/risk
 - Tracking through an internal change control process
 - With a strong technical and management team

CD-1 SCOPE		CURRENT REFERENCE SCOPE
10kt Surface detector	→	10kt underground detector
No near neutrino detector or facility	→	Fine grain tracker and its facility
700kW initial beam	→	1.2MW initial beam
Conventional Facilities at Far Site (CFFS) for 10kt surface detector	→	Excavation for 34kt, outfitting for 10kt



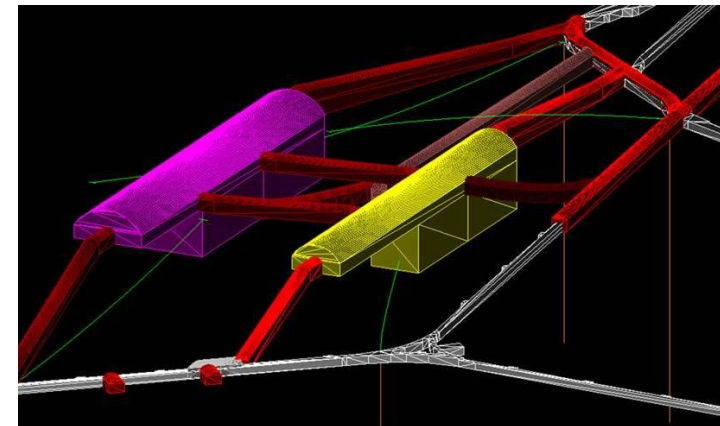
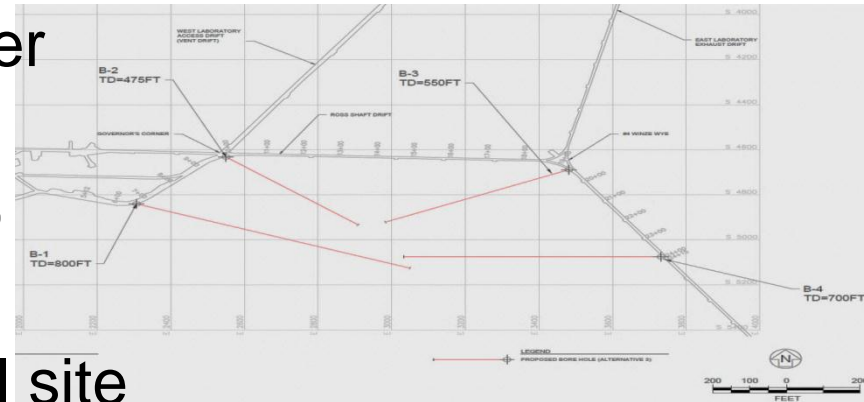
CD-1 to present – Far Detector

- Built and ran 35t cryostat prototype
- Developed several photon detector alternates and tested in smaller cryostats
- Developed prototype for high-speed DAQ
- Cold ADC designed and now under test
- FPGA-based board ready for testing
- Continued work on full detector cryo subsystem layouts & designs
- Drafted RFP for full detector cryostat design and material procurement
- Planned and prepared for 35t phase 2 – single phase detector prototype to test as many components of the final detector as possible



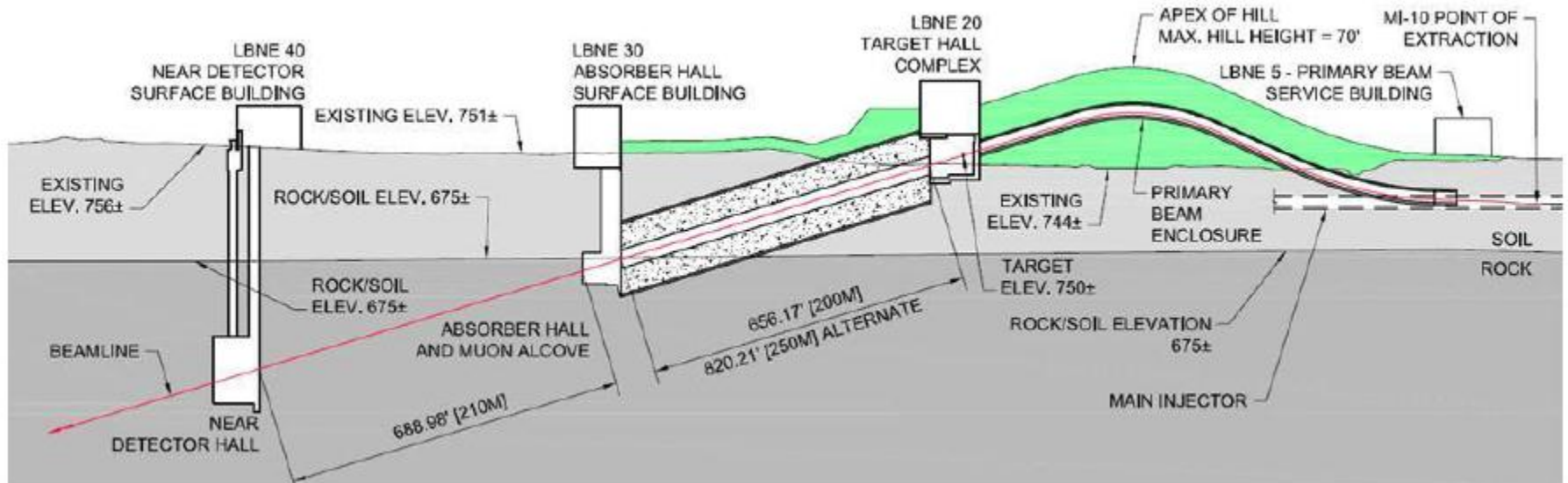
CD-1 to present – CF Far Site

- Architect/engineering firm under contract
- Revised scope from surface to underground site
- Executed generic geotechnical site investigation program for SURF area near Ross Shaft
- Preliminary evaluation of impact of geometry on rock mass behavior using 2 caverns of differing sizes
- Evaluated waste rock removal options



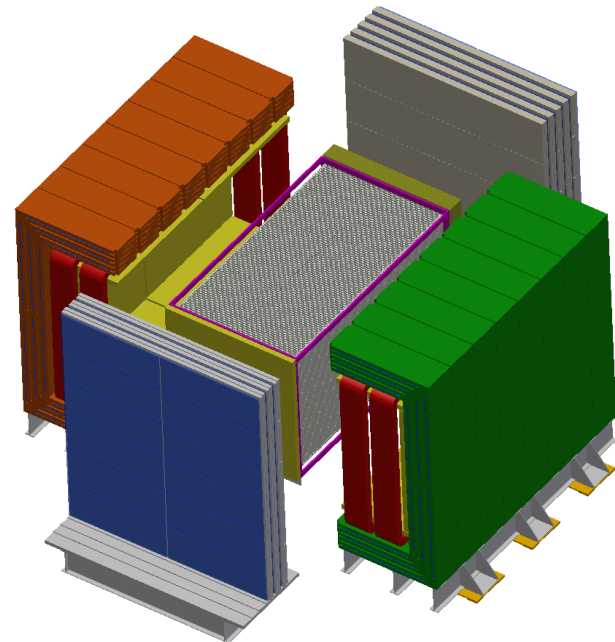
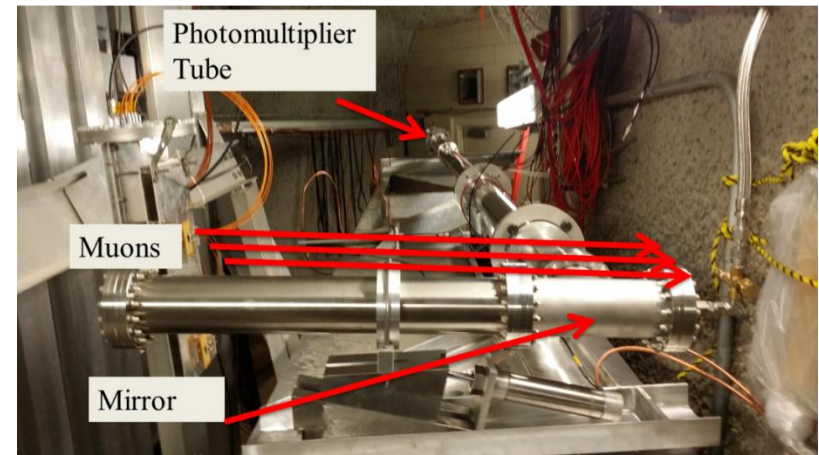
CD-1 to present - Beamline

- Changed from air-filled to helium-filled decay pipe to increase flux
- Increasingly detailed reviews and evaluations of shielding and radiation protection at decay pipe and primary beam
- Detailed work on viable absorber core
- Evaluation of 700kW target, horn, window designs for 1.2 MW initial beam power, and confirmation that most are feasible with modest modification
- Optimization of remote handling and target shield pile



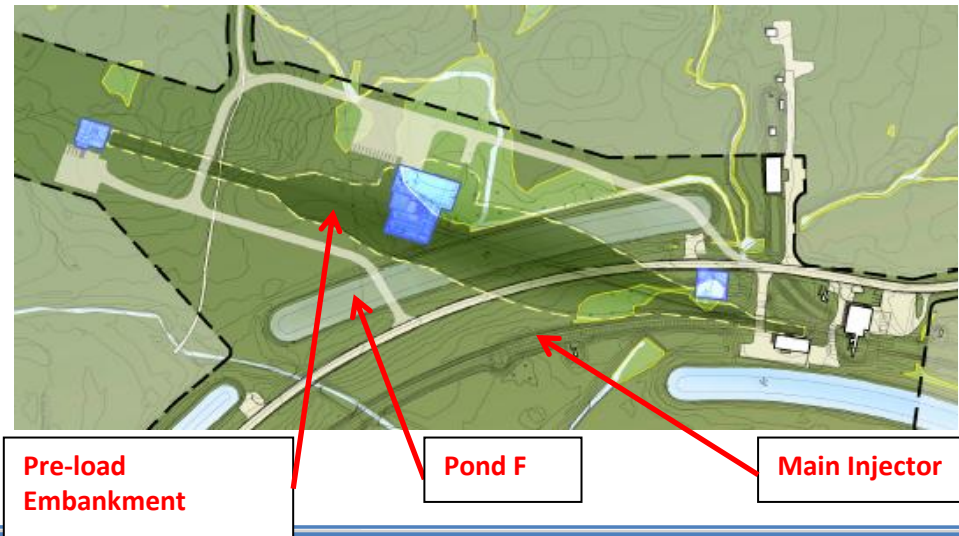
CD-1 to present – Near Detector Systems

- Developed muon detector prototypes and installed initial set in NuMI post-absorber alcoves
- Added near neutrino detector into scope, presently assumed to be high-precision fine-grain tracker proposed by Indian colleagues
- July 2014 NND Workshop
- Open to additions/alternatives



CD-1 to present - CF Near Site

- Architect/engineering firm under contract
- Geotechnical site investigation completed
- Planning for 2 major construction packages
- 1st package: Advance Site Preparation for early pre-load embankment construction to allow at least one year of settlement, plus cooling/utility installations
 - Preliminary design is 50% complete



SURF Status

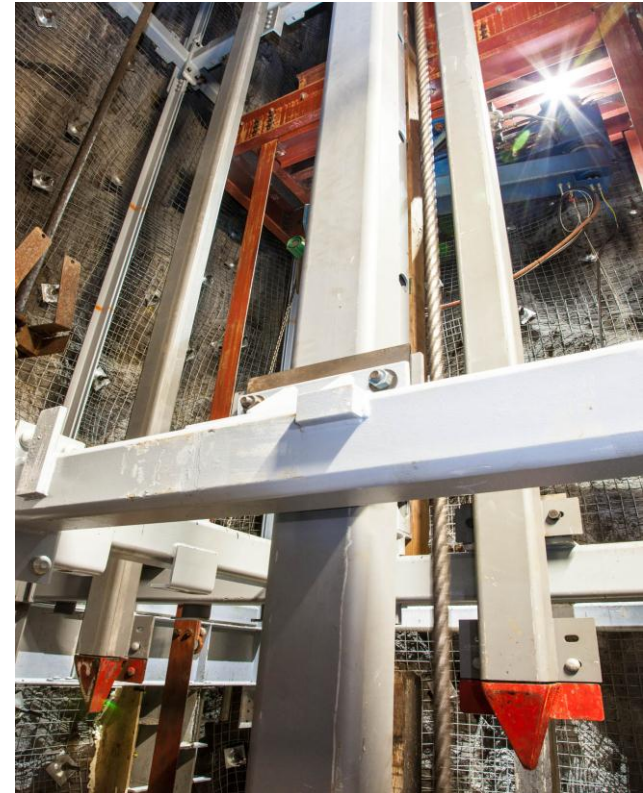
Current underground science program

- Majorana Demonstrator for neutrinoless double-beta decay
- LUX dark matter experiment and planning for G2: LZ
- CUBED: Center for Ultra-Low Background Experiments in the Dakotas
- Berkeley Low-Background Counting Facility
- Biology, geology, and engineering smaller experiments



SURF Facility Progress

- South Dakota as a state has invested over \$130M to the facility and current experiments.
 - Includes \$16M in Davis Campus and Ross Shaft rehab.
- Ross shaft rehab (ground support and replacing steel framing) is ~ 35% complete and is on track to completion in early 2017, difficult to accelerate due to space and safety conditions. This is on the critical path to being able to use the shaft for LBN access and rock removal.
- SDSTA is part of our project team – they recognize the importance of this experiment and project to SURF.



NEPA – National Environmental Policy Act

- U.S. government policy/process to assess impacts to environmental, cultural, and historic resources during federal project activities.
- Formal, public process required to be concluded before DOE CD-2 and/or approval for construction, whichever comes first.
 - Requires a variety of studies, writing an Environmental Assessment (EA) document, holding public meetings and gathering input
 - DOE makes final determination of Finding of No Significant Impact or that an Environmental Impact Statement is necessary
 - for present LBNE configuration, working towards FONSI.
- EA process includes both Fermilab and Far Sites (presently SURF).
- Have been working since fall 2012 – poised to begin final draft EA before releasing for public meetings for SURF site.

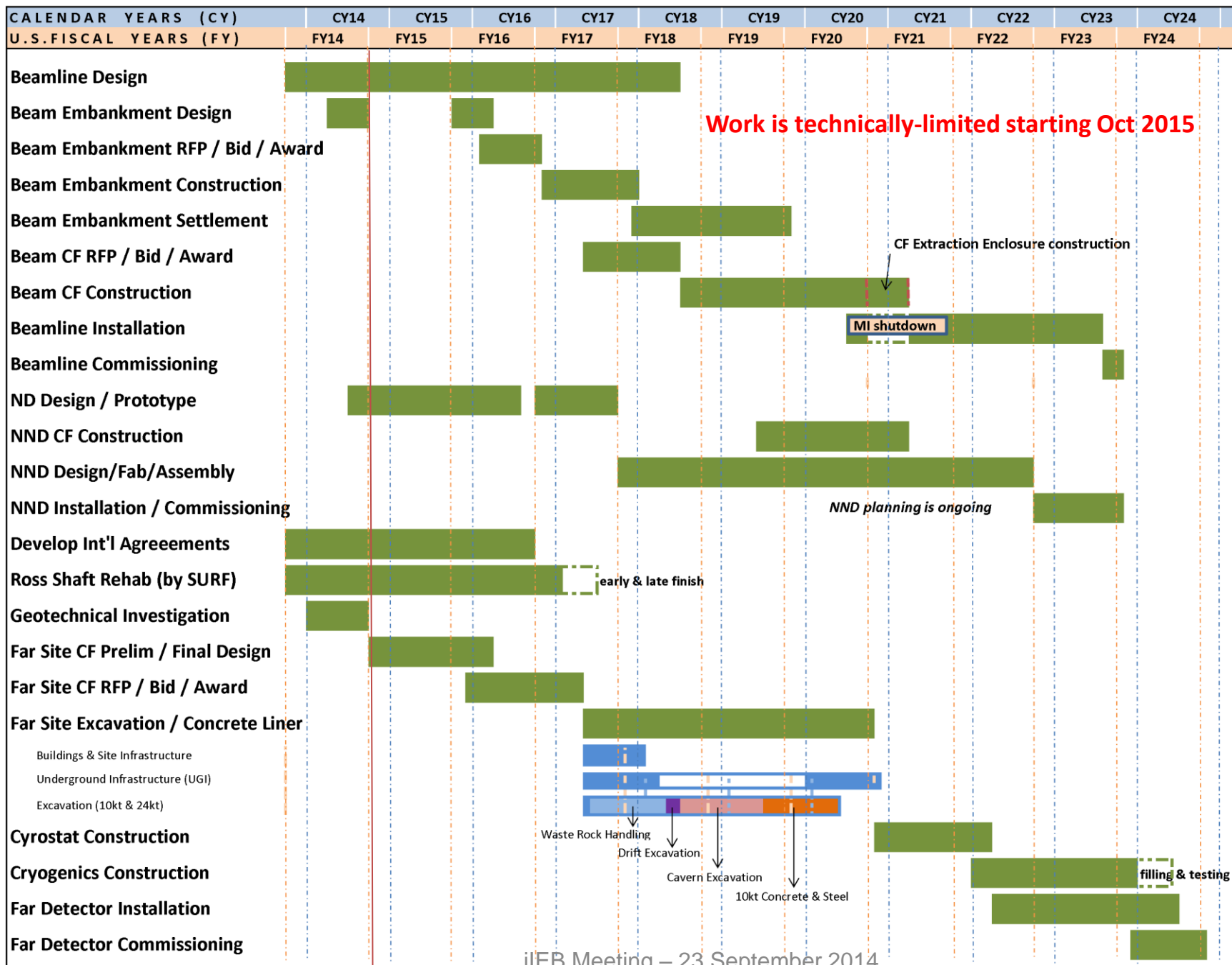
Budget for current reference scope (as-year \$M)

WBS	L2 PROJECT	ACTUAL COST THROUGH AUG-14	BCWS TO GO	CONTINGENCY		TPC TO GO	TPC
				\$	%		
130	LBNE	80	859	316	37%	1,176	1,256
130.01	Project Office	14	44	20	46%	64	78
130.02	Beamline	14	123	42	34%	165	178
130.03	Near Detector Systems	7	18	3	18%	21	28
130.04	Far Detector - WCD	10					10
130.05	Far Detector - LAr	22	194	66	34%	260	282
130.06	Conventional Facilities	13	480	186	39%	666	679

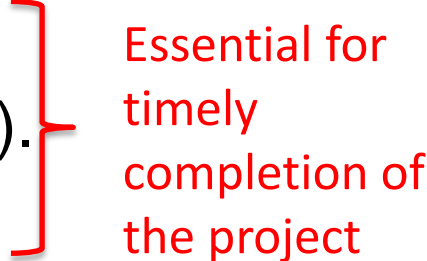
- Does not include near neutrino detector as might be provided by India, but does include CF.
- Budget in U.S. DOE accounting, so includes escalation, overheads, contingency, and all but the scientific labor
- Work is technically-limited starting Oct 2015

Potential Technically-Limited Schedule for International LBNE

19 Sep 2014



FY15 Goals

- Through iIEB, submit LOI, complete full proposal to move an LBN experiment & project forward.
 - Complete 35t prototype.
 - Start CF design at SURF (if this is the FS).
 - Develop full-scale FD prototype.
 - Make progress on better integration with CERN and RAL on beamline and cryogenics.
 - DOE/DAE sign Annex II and start NND development.
 - Keep moving on other aspects of the project.
- 
- Essential for
timely
completion of
the project

FY15 Priorities – limited by Continuing Resolution

Priorities focus on far site over near site work:

- Any work necessary to support reformulation process, likely in iIEB Working Groups evaluating alternatives.
- 35t prototype detector installation & operation
- Develop teams and plans to coordinate with SBN and CERN program on detector development
- With goal to be ready to start excavation work ASAP after Ross Shaft rehab in 2017, initiate CFFS excavation design (planned for October)
- Continue muon detector prototyping in NuMI beamline
- Continue collaborating with India on NND planning
- Continue 1.2MW neutrino beam development, including optimizing beam designs in conjunction with partners and R&D on higher power/longer life targetry
- Stop preliminary design on CFNS

FY15 Budget under Continuing Resolution

		\$M	
130	LBNE Project	22.6	Resource comments
130.01	Project Office	3.8	Labor at Fermilab and BNL
130.02	Beamline	5.2	Labor mainly at Fermilab
130.03	Near Detector Systems	1.2	Labor mainly at LANL and universities
130.05	Far Detector	8.0	Labor at Fermilab, BNL, SLAC, ANL, universities
130.06	Conventional Facilities	4.4	Small labor at Fermilab & SURF, mainly contracts

Summary

- LBNE Project CD-1 provides a basis in the U.S. upon which a long-baseline neutrino experiment and facility can be developed.
- Funds spent so far have developed designs, costs, schedules, and a project team that are available and can be useful for future configurations.
- In FY15 work will advance far detector prototyping, development of partnerships, and the understanding of underground excavation, along with lower level, but important effort on neutrino beamline and near detectors.